No. XII.

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An easy Solution of a useful Problem in Arithmetic. By James Austin.—Read November 3, 1815.

THE committee to whom were referred the papers from Mr. James Austin, of Lycoming County, Pennsylvania, relative to an easy solution of a useful problem in arithmetic, recommend that the following abstract of the same be published in the transactions of the society.—[*Adopted.*]

IN casting up the contents of a survey or inclosure of land, from the course and distance of its several boundary lines, as well as in many other parts of practical mathematics, it becomes a necessary problem—" To find the sum or difference of the products of any number of given factors."
The following process, it is presumed, exhibits a very easy and expeditious solution of this problem, by simple addition :—
1. You rule out nine columns, or vertical spaces, which you number, at the head, 1, 2, 3, &c.
2. In those columns, you write down, in succession, the several multipliers, each under the digits of its multiplicand at the top of the columns; observing to set the units figure of each multiplier in such place of the column, as the figure at the top occupies in its multiplicand.

3. You add up the numbers in column 9, and set down the sum : to this sum you add the numbers in column 8, and set down the sum, under the former : to this last sum you add the numbers in column 7, and so on, with all the other columns.

4. You add together the nine sums before found, and their sum will be *that* of the products required.

This process will be better understood from the following examples.

EXAMPLE I.

Let it be required to find the Sum of the Products of the following Factor, viz.

$$342 \times 756$$
$$301 \times 127$$
$$89 \times 1634$$
$$120 \times 97$$
$$551 \times 27.4$$
$$6.8 \times 16.9$$

1	2	3	4	5	6	7	8	9
30100	3010	890	89	3420	342	34200		1200
89000	5310		55.1		8900	301		.68
68					6.8	120		1200.68
						551		1200.68
								36372.68
								45621.48
								49041.48
								49185.58
								50075.58
								58595.58
								177763.58

Sum of products = 469057.32

EXAMPLE II.

Let it be required to find the Difference of the Products of the following Factors, viz.

42 × 72
35 × 19
73 × 81
122 × 25

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34 × 14
56 × 18
13 × 14.3

1	2	3	4	5	6	7	8	9
350 73	42 1220			122		420	730	35
340 560 130		1.3	34 13				56	35 709 1129 1129 1251 1204 1202.7 2464.7 1857.7

Diff. of products = 10982.1

EXAMPLE III.

(Taken from Gibson's Surveying.)

Let it be required to find the Area of an Enclosure, of which the Meridian Distances (or Multipliers) and Differences of Latitude are as follows, viz.

$$235.3 \times 14.2 \text{ N.}$$
$$302.6 \times 38.6 \text{ N.}$$
$$368.7 \times 117.7 \text{ S.}$$
$$228.7 \times 15.5 \text{ S.}$$
$$166.6 \times 36.0 \text{ N.}$$
$$120.5 \times 4.9 \text{ S.}$$
$$37.2 \times 27.8 \text{ N.}$$
$$46. \times 61.5 \text{ N.}$$
$$113.4 \times 51.7 \text{ N.}$$
$$181.5 \times 11.0 \text{ S.}$$
$$217.0 \times 41.6 \text{ S.}$$
$$194.1 \times 38.8 \text{ S.}$$

1	2	3	4	5	6	7	8	9
490	155	11770	38.8	.49	1177	11.77	117.7	388
11	1550	1.42	615	1.1	3.68	1.55	15.5	388
1100	49	142	5.17	14.2	3.6	41.6	110	631.2
416	4160	3860			36	27.8		586.12
3.88	1420	278			360	492.76		1863.12
3880	38.6	51.7			61.5	506.96		1864.71
3600	2.78					1127.13		1903.51
517						5460.25		13663.51
5170						6921.63		19587.51
						16208.63		25488.39
						30745.16		66086.07
								30745.16

$$2)\overline{35340.95}$$

Area in per. $= \overline{17670.45}$

EXPLANATORY REMARKS.

1. In Example I. the first multiplier, 342, is set down in the columns, three times; viz. under 6, 5, and 7, the digits of its multiplicand; the units figure, 2, in the units' place of column 6, in the tens' place of column 5, and in the hundreds' place of column 7; and so of all the other multipliers, respectively.

2. The sum of the multipliers in column 9 amounts to 1200.68. This sum added to the multipliers in column 8, (0) gives the same number; and this again added to the multipliers in column 7, amounts to 36372.68; and in the same manner the remaining sums are found, as in the example.

3. From the above process it is evident, that the sum of the numbers in column 9 is taken 9 times; [multiplied by 9] that in column 8, 8 times; that in column 7, 7 times, &c. and the aggregate of those sums is evidently the sum of the products required.

4. In Example II. where the *difference* of the products of given factors is to be found, the multipliers of the products to be subtracted, are placed under a line separating them from the other multipliers; and in adding up the numbers in the respective columns, the *co-arithmetical* (as it may be called) of the subtrahends are taken; i. e. what the right hand significant figures want of 10, and what all the others, respectively, want of 9; subtracting 1 from the next vertical line of figures on the left of each subtrahend. This mode of adding and subtracting at the same time, is frequently practised in trigonometry, and readily demonstrated.

5. In Example III. instead of taking the co-ar. of the subtrahends, which, in some cases, is a little embarrassing, the respective sums of the north and of the south products are found separately, and then their difference taken. This operation, though a few more figures are employed, is, however, much more simple, and requires no more time, but perhaps less, than when the co-ar. is used.

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6. Almost in all cases, especially where the number of products is considerable, the above method, by simple addition, has greatly the advantage over the common method by multiplication, both in respect to facility and expedition; as will be evident to any one who will make the comparison.

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